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Short Communication

Vegetable Juices Improved Depression and Anxiety in Slightly Depressed Individuals

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- Beta-carotene

Abstract

Aim: The purpose of this study was to assess the effects of vegetable juice on depression and anxiety scores in slightly depressed individuals.

Methods: Sixty-six research participants were randomized to 3 groups: group A, plain vegetable juice; group B, vitamin-fortified vegetable and fruit juice; group C, control. Vegetable juices were administered for 12 weeks. The Beck Depression Inventory (BDI) and State-Trait Anxiety Inventories (STAI) 1 and 2 were administered 4 times and a blood sample was also obtained from each participant for measurements of folic acid, magnesium, and beta-carotene.

Results: A significant decrease in depression and anxiety was found in groups A and B at 12 weeks. In group A, 70% of the participants yielded a decrease of 3 or more points for the BDI and STAI-2 scores, and 80% of them did so for the STAI-1 score. In group B, 50% of the participants yielded a decrease of 3 or more points for the BDI and STAI-1 scores, and 70% of them did so for the STAI-2 score. Among the blood nutrients studied, an inverse linear correlation was found between the BDI score and blood beta-carotene level (Pearson $r = -0.587$; $P < .01$). The STAI-1 score and blood beta-carotene level were also inversely correlated (Pearson $r = -0.560$; $P < .05$).

Conclusion: Our findings suggest that vegetable juice intake may be associated with improvement of depression and anxiety in slightly depressed individuals.

INTRODUCTION

Recently, Nanri *et al* reported that a prudent dietary pattern characterized by a high intake of vegetables, fruits, potatoes, soy products, mushrooms, seaweed, and fish was associated with a decreased risk of suicide [1]. Nutritional factors such as zinc and folic acid could theoretically have an influence on brain structure and function, including mood. Our group also showed that folate correlated with depression and anxiety in apparently healthy individuals [2]. Our preliminary cross-sectional study also showed that intake frequency of vegetable juice is associated with BDI and STAI scores.

Vegetable juice contains many nutrient factors (such as folic acid, magnesium, and beta-carotene) that could affect mental status. In this study, we assessed the effects of vegetable juice on depression and anxiety scores in slightly depressed individuals.

MATERIALS AND METHODS**Research participants**

We recruited 66 volunteers (17 men and 49 women, aged 25-60 years; average age, 41.9 ± 13.1 and 40.2 ± 11.2 years, respectively) who had slight depression and anxiety (BDI > 11; STAI-1 or -2 > level 3). The participants were employees of the University of Tsukuba Hospital. At entry, all participants provided written informed consent to participate in the study. The data were collected from May through August 2014 and analyzed in September 2014.

The study protocol was approved by the ethics committee of the Institute of Medicine, University of Tsukuba (no. 836).

Vegetable juice contents

We used 2 kinds of vegetable juice: Ichinitibun no yasai (ITO

EN, Tokyo, Japan), a plain vegetable beverage containing the equivalent of 350 g of vegetables, and Bitamin-yasai (ITO EN), a vitamin-fortified vegetable beverage containing the individual recommended daily intake of vitamin in the 12 kinds of vitamins by Ministry of Health, Labor and Welfare in Japan. The nutrient contents of the juices are summarized in (Table 1).

Depression and anxiety scoring

The BDI is used for measuring the severity of depression, and the STAI, for measuring 2 types of anxiety: state anxiety (STAI-1) and trait anxiety (STAI-2).

Measurements of nutrients in blood

Peripheral venous blood samples were collected at around 5 PM into tubes containing serum separator gel. Beta-carotene was determined using high-performance liquid chromatography (HPLC). Serum magnesium and calcium levels were measured using an automated analyzer (Hitachi 7700; Hitachi High Technologies Corporation, Japan). Folic acid levels were measured using a chemiluminescence assay (Siemens Healthcare, Japan).

Statistical analysis

Analysis of variance (ANOVA) was used to evaluate interactions between each group over the study period. The Pearson product moment correlation was used to determine correlations among the quantitative variables. Statflex version

6 software (Ah-tec, Osaka, Japan) was used for all statistical analyses.

RESULTS

Depression and anxiety scores

As shown in (Table 1), the mean BDI scores gradually decreased, and the decrease was significant in groups A ($P < .01$) and B ($P < .05$) at 12 weeks. The mean STAI-1 score also gradually decreased in group A and was significant at 4 weeks ($P < .05$) and 8 weeks ($P < .01$). The mean STAI-2 scores had decreased after 8 weeks and the decrease was significant in group A at 12 weeks ($P < .01$) and in group B at 8 weeks ($P < .05$) and 12 weeks ($P < .01$).

Blood nutrients

The mean folic acid level had significantly increased in group B at 4 weeks and had increased to its maximum level at 8 weeks. The mean beta-carotene level increased gradually but significantly in group A.

Correlations between mental health scores and biomarkers

Correlations between the mental health scores and blood nutrients levels are summarized in (Table 3). An inverse linear correlation between the BDI score and beta-carotene was found in all participants (Pearson $r = -0.587$; $P < .01$). The STAI-1 score and beta-carotene were also inversely correlated (Pearson $r = -0.560$; $P < .05$).

DISCUSSION

In the present study, we showed that vegetable juice intake decreased depression and anxiety scores and that the pattern of the effects on depression and anxiety differed according to the kind of juice. [3,4] The plain vegetable juice beverage contains contents equivalent to 350 g of vegetables, with a high content of beta-carotene, magnesium, potassium, and calcium. On the other hand, the vitamin-fortified vegetable juice beverage contains high levels of 12 vitamins.

Lazarou *et al* reported on the correlation between folic acid deficiency and depression and the role of folic acid in the treatment of depression [5]. On the other hand, Christensen *et al* reported no clear potentiation of antidepressant medication effects by folic acid or vitamin B12 [6]. In this study, the vitamin-fortified juice intake effectively increased blood folic acid levels and significantly decreased STAI-2 scores after 8 weeks. Even though the effect varied substantially, folic acid seems to be associated with trait anxiety rather than with depression.

Beta-carotene is an antioxidant vitamin that may reduce the risk of mood disorder [7]. However, other than in a mouse experiment, [3] beta-carotene has not been studied for its potential in the management of depression. In the present study, vegetable juice intake significantly increased the blood beta-carotene level, and that level correlated with the BDI and STAI-1 scores. Further investigations such as experiments with beta-carotene-free juice should be conducted.

CONCLUSION

Vegetable juice intake may be associated with improvement of depression and anxiety in slightly depressed individuals.

Table 1: Nutrient contents (per 100g) of the vegetable juices used in this study.

Factors	Plain vegetable juice	Vitamin-fortified vegetable juice
Protein	1.0 g	0.3 g
Lipid	0.2 g	0.1 g
Carbohydrate	8.4 g	9.0 g
Energy	39 kcal	37 kcal
Na	74.1 mg	19.5 mg
K	299 mg	134 mg
P	41.2 mg	15.3 mg
Ca	67.0 mg	11.3 mg
Mg	30.1 mg	7.75 mg
Fe	0.33 mg	0.11 mg
Folic acid	24 µg	270 µg
Niacin	1.2 mg	10.8 mg
Biotin	3.8 µg	34.7 µg
Pantothenic acid	0.23 mg	5.53 mg
Vitamin A	552 µg	462 µg
Retinol	ND	254 µg
Alpha-carotene	2980 µg	1020 µg
Beta-carotene	5130 µg	1980 µg
Vitamin E	0.8 mg	6.2 mg
Vitamin B ₁	0.04 mg	0.91 mg
Vitamin B ₂	0.04 mg	1.34 mg
Vitamin B ₆	0.10 mg	1.20 mg
Vitamin B ₁₂	ND	2.6 µg
Vitamin C	57.8 mg	623 mg
Vitamin D	ND	5.0 µg
Vitamin K	5 µg	2 µg

Table 2: Effects of vegetable juice intake on BDI depression scores and STAI anxiety scores over time.

		Baseline	4 weeks	8 weeks	12 weeks
Plain vegetable juice intake, n = 18	BDI	15.7 ± 6.2	13.4 ± 6.6	12.7 ± 6.7	9.7 ± 6.3** ^a
	STAI-1	51.4 ± 9.9	46.8 ± 9.8*	46.2 ± 10.3	44.5 ± 10.5* ^a
	STAI-2	54.3 ± 9.5	51.7 ± 9.3	51.1 ± 8.2	48.4 ± 8.5**
Vitamin-fortified vegetable juice intake, n = 19	BDI	15.7 ± 7.8	14.5 ± 6.8	12.8 ± 6.7	12.1 ± 7.1*
	STAI-1	51.7 ± 8.6	52.2 ± 9.2	51.5 ± 11.8	48.5 ± 9.5*
	STAI-2	54.5 ± 7.5	55.1 ± 7.1	50.9 ± 8.2*	49.1 ± 8.5**
Control (no juice intake), n = 16	BDI	13.7 ± 7.9	15.2 ± 7.4	16.0 ± 9.9	15.5 ± 10.8
	STAI-1	54.4 ± 8.2	53.7 ± 8.7	53.6 ± 10.6	52.6 ± 11.4
	STAI-2	54.0 ± 8.7	53.3 ± 8.4	53.2 ± 10.4	51.7 ± 10.3

Abbreviations: BDI: Beck Depression Inventory, STAI: State-Trait Anxiety Inventory, * $P < .05$; ** $P < .01$ compared to baseline, ^a $P < .05$ compared to no juice intake

Table 3: Correlations among BDI, STAI, folic acid, Mg, and beta-carotene.

	BDI	STAI-1	STAI-2	Folic acid	Mg	Beta-carotene
BDI	1.000					
STAI-1	0.693**	1.000				
STAI-2	0.592**	0.870**	1.000			
Folic acid, ng/mL	-0.088	-0.363	-0.254	1.000		
Mg, mg/dL	-0.066	0.210	0.195	-0.159	1.000	
Beta-carotene, µg/dL	-0.587**	-0.560*	-0.361	-0.011	0.184	1.000

Abbreviations: BDI: Beck Depression Inventory, STAI: State-Trait Anxiety Inventory

* $P < .05$; ** $P < .01$

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